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THE JOURNAL OF ENTOMOLOGY AND ZOOLOGY

William A. Hilton, Editor

Claremont, California, U. S. A.

Isopods From Laguna Beach

The following list is from the collections of 1917. Specimens were determined by the U. S. Nat. Museum. Included in this list are a number of forms which seemed not perfectly typical, so the determinations of several listed before is especially valuable. The names of some of the species have been changed since earlier lists.

Pentidotea resecata Stimp. A number of these were determind by the Museum. Several dredged at 10 fathoms were brown with light markings. Another was uniformly light colored. One found at low tide was a pure brown with darker markings along the sides and center of the dorsum. Another dredged specimen was pure green.

Idothea rectilinea Lock. A very narrow species. Some are almost black mottled with silver. Other specimens are a lighter brown with no silver marks.

I. fewkesi Rich. Large, elongated, yellow-brown, telson pointed.

Paracercis cordata Rich. Brown, dredged 10 fathoms, spines on telson.

P. caudata Say. Coral pink, spines at end of body. Dredged 10 fathoms.

Tanais normani Rich. Small, elongate, among Bryozoa.

There were also in this lot, specimens of a new genus of the family Apseudidæ. These were narrow elongate forms. There was also a new genus and species of the family Anthuridæ. Specimens of this last were pinkish and the caudal end toothed. Neither of the last two species was described at the time this list was sent to the printer. Notes on these will be given later.—W. A. H.

(Contribution from the Zoological Laboratory of Pomona College)

Bryozoa Collected at Laguna Beach in 1918

GENEVIEVE CORWIN

The following list of species includes only those not listed before from this locality.

INCRUSTING

Smittia reticulata Macg. Dredged 10 fathoms.
Microporella californica Busk.

NON-INCRUSTING

Stirparia ciliata Rob.?
Bugula laxa Rob.
Bugula sp.

(Contribution from the Zoological Laboratory of Pomona College)

Phalangids from the Claremont-Laguna Region

The species here listed have been collected during the past two or three years. All determinations but the last two are by Dr. Nathan Banks.

Liobunum exilipes Wood. This is the most common species in the Mts. In the fall great masses of these may be found on vertical rock surfaces.

Protolophus tuberculatus Banks. These are found in the lower altitudes, and not so much in the Mts.

P. singularis Bks. In and about Claremont.

Ortholasma rugosa Bks. Laguna Beach and Evey Canon 3,000 ft. elevation.

Globipes spinulatus Bks. Claremont.

Leptobrunus californicus Bks. Near Claremont.

Erybrunus brunneus Bks. Claremont. W. A. H.

(Contribution from the Zoological Laboratory of Pomona College)

Isoptera from Claremont-Laguna Region

All specimens were determined by Dr. Nathan Banks.

Reticulitermes tibialis Bks. Medium sized. Collected at Claremont. Winged forms were found in front of Science Hall Nov. 12, '17. They were also found in other parts of the region.

Reticulitermes Sp. From near Claremont and from Middle Ranch, Catalina Island.

R. hesperus Bks. Small dark colored winged forms collected in Holmes Hall, May, 1913. Also some soldiers and workers from Evey canon, Nov. 8, 1917. Also from the interior of Catalina Island.

Termopsis augusticollis Hag. Large specimens. Palmer's canon, 1918.—W. A. H.

(Contribution from the Zoological Laboratory of Pomona College)

Diplopods from the Claremont-Laguna Region

The determinations were made by Dr. R. V. Chamberlin.

Parajulus furcifer Hag. Small species collected by Ivan Johnson altitude 5,200 ft. San Antonio canon. Dec. 21, '17. Also from Red Hill near Upland.

Atopetholus parvus Chamb. From near Claremont.

A. californicus Chamb. From near Claremont.

Tylobolus claremontus Chamb. Large species from Claremont and Mts. near.

W. A. H.

(Contribution from the Zoological Laboratory of Pomona College)

Notes on Serpent Stars from Laguna Beach

During the summer of 1918, all species were found that had been previously reported from this locality, largely by Miss Wortha Merritt.

From the Balboa mud flats the long-armed serpent stars *Amphiodia barbaræ,* were taken again. This and one other species were the only ones sent to Dr. H. L. Clark for determination.

For a number of years we have been finding serpent stars of medium size with dark brown markings. These were at first confused with others but as they seemed different from all others reported, one was sent to Dr. Clark for determination. They were determined by him as follows:

"*Ophiopteris papillosa,* a relatively rare ophiuran. . . . The genus is peculiar for its flat, nearly circular upper arm spines. It is most desirable to know if there is anything in the habits or habitat to account for this—"

This species seemed not uncommon in the littoral zone at Laguna Beach. A few were obtained from kelp holdfasts from deep water, but last summer Miss Merritt found them especially abundant in rocky tidepools containing many sea-urchins. The serpent stars were around and under the sea-urchins.—W. A. H.

(Contribution from the Zoological Laboratory of Pomona College)

Smaller Shells Collected at Laguna Beach During the Summer of 1917

EVA MAY HYDE

The shells illustrated are all small specimens. Nearly all were determined by Mrs. T. S. Oldroyd. All drawings are three times the natural size unless otherwise stated. S is for shore collection under stones, D for shells dredged about 10 fathoms just off shore. When colors are evident some indication is given in the list. Many are young.

1. *Turbonilla jewetti* D. and B. Shore.
2. *T. tenuicula* Gld. S. Old Det.
3. *T. buttoni* D. and B. S. Old Det.
4. *T. tenuicula subcuspidata* Cpr.? Dredged. Old. Det.
5. *T. laminata* Cpd.? D. Old. Det.
6. *Cerithiopsis pedroana* Bart. S. Det. Old.
7. *Seila assimilata* Cpr. S. White. Det. Old.
8. *Metaxia diadema* Bartsch D. Old. Det.
9. *Eulima (Melanella) rutila* Cpr.? D. Glossy white.
10. *Bittium quadrifilatum* Cpr.? (Young) D. Old. Det.
11. *Rissoina kelseyi* Bartsch D. White. Old. Det.
12. *Cæcum crebricinctum* Cpr. D. Light brown. Det. Old.
13. *Cæcum californicum* Dall. S. and D. White. Det. Old.
14. *Columbella carinata* Hds. Immature. D. Light.
15. *C. turberosa* Cpr. D.
16. *C. gausapta* Gld. S. Brown. Old. Det.
17. *Alectrion mendica* Gld.? D. Old. Det.
18. *A. fossata* Gld.? D. White.
19. *Amphissa corrugata* Rve. (Young) S. Old. Det.
20. *A. versicolor* Dall D. Juv. Old. Det.
21. *Lacuna unifasciata* Cpr. S. Tan striped with brown. Old.
22. *Astyris gansipata* Gld. S. Tan and brown.
23. *Anachis penicellata* Cpr. S. Det. Old.
24. *Thais emarginata* Desh. S. Young. Tan and brown. Det. Old.
25. *Cerithidea californica* Held. ½ Natural size (Young). S. Balboa. Gray. Old.
26. *Arcularia (Nassa) tegula* Rre. Young ½ Natural size, Balboa. S. Gray. Old. Det.
27. *Saxicava arctica* Linn. Young ½ Natural size. S. Dirty white. Twisted shell. Old.
28. *Dialia acuta* Cpr. D. White. Old. Det.
29. *Eulithidium substriatum* Cpr. S. Dark pink. Old. Det.
30. *Phasianella pulloides* Cpr. S. Tan. Old. Det.
31. *Odostomia fatella* Bartsch. S. Old. Det.
32. *Tritonalia* Sp. (very young) White.
33. *Melanella thersites* Cpr. White D.
34. *Marginella pyriformis* Err. D. Dirty white, polished. Old. Det.
35. *Liotia fenestrata* Cpr. S. White. Old.
36. *Leptothyra carpenteri* Pils. Tan. Old.
37. *Tritonalia interfossa* Cpr.? S. Old. Det.
38. *Acmæa* sp. D. White.
39. *Margarites acuticostatus* Cpr. D.
40. *Tegula viridulum ligulatum* Mke. Very young. D. Old. Det.
41. *Hipponyx* Sp. D.
42. *Philobrya setosa* Cpr. S. White.
43. *Marginella varia* Sby. S. Glossy.
44. *Cardita subquadrata* Cpr. S. White. Old.
45. *Littorina scutulata* Gld. S. Brown.
46. *Tornatina cerealis* Gld. White.

47. *Erato columbella* Mke D. White.
48. *Paphia tenerrima* Cpr. Juv. Old. Det.
49. *Calliostoma annulatum* Mast. D. Det. Old.
50. *Olivella pedroana* Conr. ½ Nat. size. S.
51. *Septifer bifurcatus* Rve. Young.
52. *Mytilus californianus.* Conr. Young.
53. *Dentalium semistriatum* Br. and Sby. D. White.
54. *D. neohexagonum* S. and P. White.
55. *Macron lividus.* A. Ad. (young) Brown. Shore.
56. *Epitonium hindsii* Cpr. S. White. Often found on sea anemones. *E. crenatoides* Cpr. was found in similar locations.

Nucula castrensis Hinds. At low tide common under stones.
Malletia faba Dall. These were dredged or found in holdfasts.
Lima dehiscens Conr. These were found in holdfasts of kelp.
Botula (Adula) falcata Gld. This elongate rock borer was found but not so commonly as the other similar species.
Leptothyra paucicostata Dall. S. Old. Det.
Columbella tuberosa Cpr. Old. Det.
Marginella pyriformis Cpr.

(Contribution from the Zoological Laboratory of Pomona College)


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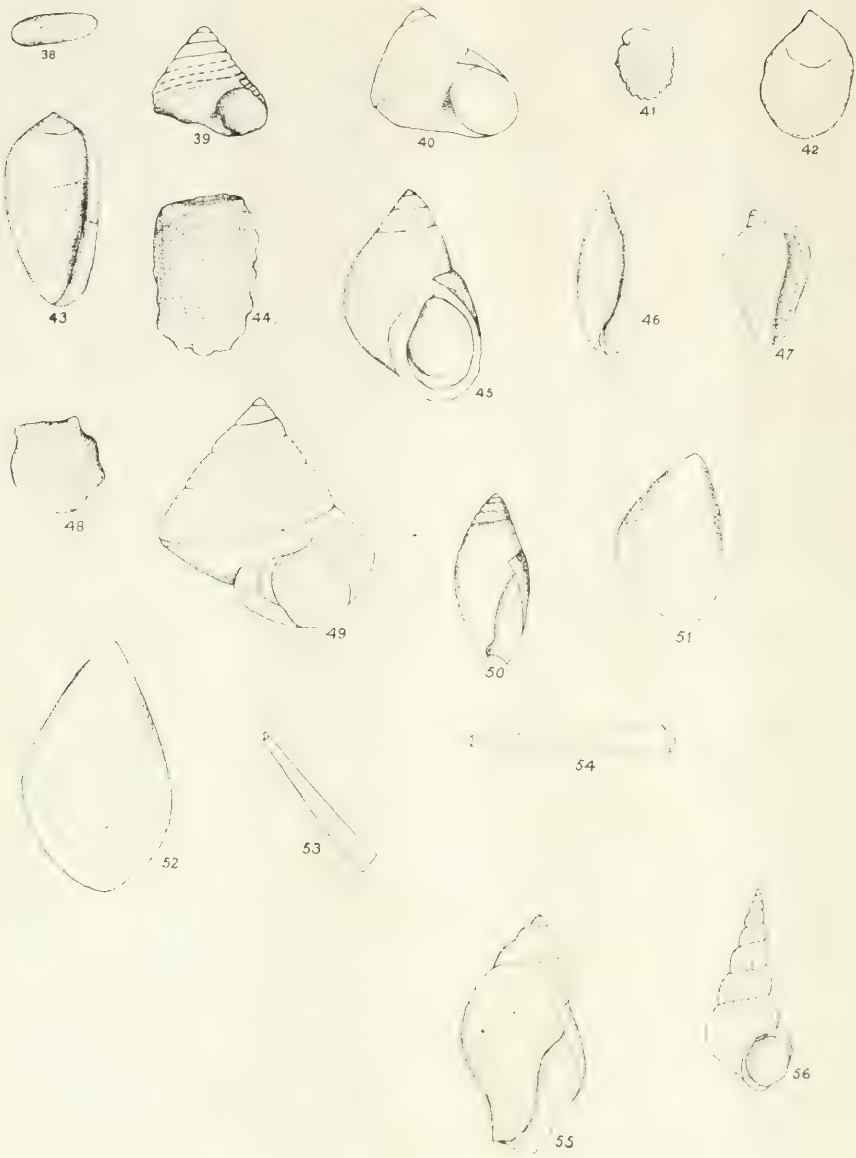
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Notes of the Ancestry of the Coleoptera*

BY G. C. CRAMPTON, PH. D.

There are three principal theories concerning the probable nature of the ancestors of the Coleoptera. In one of these, it is maintained that they were like Neuroptera, in another it is maintained that they were like Blattids, and in a third, it is maintained that they were like Dermaptera.

The chief reason for assigning the Coleoptera a position near the Neuroptera is that both groups exhibit a complete metamorphosis, and since the Neuropters are considered to be the most primitive of insects with complete metamorphosis, they are regarded by many as the nearest living representatives of the ancestors of holometabolous insects, including the Coleoptera. The nature of the metamorphosis exhibited by the two groups, however, is not adequate evidence for placing them near together, unless a study of the comparative anatomy of the two orders would bear out such an assumption, since a complete metamorphosis occurs in some Hemipteroid insects (Coccidæ) and not in others, and its presence or absence is therefore not sufficient proof of relationship unless supported by the evidence of comparative morphology as well. If both Neuroptera and Coleoptera are ultimately to be traced back to Plecoptera-like forbears (as seems to be the case) it is possible to maintain that tendencies present in the Plecopteroid stock (such as the rather marked difference between the nymphal and adult forms apparent in certain Plecoptera) could reappear and find opportunity for greater development in two distinct lines of descent ultimately derived from such a common stock, if both were subjected to similar environmental or selectional influences. The similarity between larval Coleoptera and Neuroptera in the nature of their thoracic sclerites and other structures has been referred to in an article recently published in the Proceedings of the Entomological Society of Washington; but, as I there stated, other structural similarities between the Coleoptera and the members of the group to which the Dermaptera belong would greatly outweigh the above mentioned resemblances between the Coleoptera and Neuroptera.

Some of the lower Coleoptera such as the Lampyridæ, etc., have broad pronota and flattened bodies bearing a superficial resemblance to certain Blattids; and, since there is a marked tendency toward a thickening of the fore wings to form tegmina in the latter group, this is taken as evidence of the ancestral nature of the Blattids by certain investigators who would seek to derive the Coleoptera from Blattoid ancestors. On the other hand, a comparison of the anatomical structures of the Coleoptera with those of the members of the group next to be considered (the Panplecoptera), has brought to light similarities so much more profound and far reaching (even with regard to the minuter details) that I have become convinced that the closest affinities of the Coleoptera are with the members of the group in question, and that the Dermapteron representatives of this group approach extremely closely to the Coleoptera in their lines of devlopmnt. The Dermaptera alone, however, have by no means retained all of the ancestral features present in the forebears of the Coleoptera,

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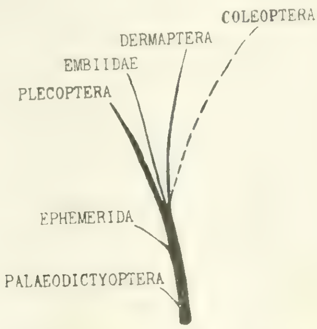
*Contribution from the Entomological Laboratory of the Massachusetts Agricultural College, Amherst, Mass.

having developed many specializations of their own and having lost many ancestral features in the process, but they appear to have departed as little as any known forms from the probable ancestral condition of the Coleoptera; and certain other members of the group to which the Dermaptera belong have retained some of the ancestral features which the Dermápters have lost, so that it is necessary to make a study of the composite characters of the group as a whole in attempting to determine what the ancestors of the Coleoptera were probably like.

Before taking up the discussion of the relationship of the Coleoptera to the other members of the group "Panplecoptera," it is necessary first to point out the interrelationships of the insects comprising this group, and the appended diagram is given in order to make these relationships more readily apparent. The primitive fossil Palæodictyoptera are doubtless very like the ancestors of winged insects in general, and some of them are quite closely related to certain members of the group Panplecoptera. The Ephemerida are among the most primitive living representatives of the forms which branched off very near the base of the Panplecopteron line of development, but the Plecoptera are the most important of the insects actually composing the group, having retained more of the characters occurring in the common ancestral forms which gave rise to the different lines of descent of the insects composing the group, and their line of descent is therefore made much heavier in the diagram, to emphasize their importance as the nearest living representatives of the ancestors of the rest of the insects in the group.



The nearest relatives of the Plecoptera are the Embiidæ (*Sensu lato*) whose line of development parallels that of the Plecoptera remarkably closely—in other words, the two groups have retained many features in common. The Dermaptera (Euplexoptera), among which are included the Hemimeridæ, have rather more features in common with the Embiidæ than with the Plecoptera, but the Plecoptera also exhibit many features which are retained by the Dermaptera, and I am inclined to regard the Plecoptera, rather than the Embiidæ, as the nearest living representatives of the ancestral forms which gave rise to the Dermapteron line of descent. As I have pointed out in a paper on the thoracic sclerites of immature winged insects (Proc. Ent. Soc. Washington, 1918) the thoracic sclerites of the Dermapteron *Arixenia* are remarkably like those of certain immature Plecoptera as is also true of the head region, the nature of the cerci (of immature Dermaptera such as *Diplatys*, etc.), and many other features which need not be enumerated here, since I propose to take them up in another paper dealing with the ancestry of the Dermaptera, etc.

As was stated above, the Dermaptera have many features in common with the Embiidæ and Plecoptera, and similarly, the Coleoptera (whose line of development appears to parallel that of the Dermaptera quite closely) have also retained certain features which occur in the Embiidæ and Plecoptera. Since the Coleopteron line of development parallels that of the Dermaptera quite closely, and since the Dermaptera have rather more in common with the Embiids than with the Plecoptera, the Coleoptera also are rather more like the Embiids than they are like the Plecoptera, as might be expected. Bearing these facts in mind, and taking the composite features of the superorder Panplecoptera as a whole, for comparison with the composite characters of the Coleoptera as a whole (since some members of a group will retain certain primitive features which other members do not retain), I would point out the following similarities between the Coleoptera and the other members of the superorder Panplecoptera, which, to my mind, indicate that the ancestors of the Coleoptera were like certain insects belonging to this superorder rather than to any other

Both the Coleoptera genuina and the Dermaptera are typically prognathous (mouth parts directed forward) as is true of most of the insects belonging to the superorder Panplecoptera. The segments of the antennæ in certain Coleoptera, such as the Cerambycids, etc., are very like those of certain Dermaptera. The nature of the maxillæ with its peculiar subdivisions in these two groups is markedly similar in both Coleoptera and Dermaptera. The character of the labium of the Coleopteras, on the other hand, is more like that of the Embiids, in which there is a tendency toward the union of the under lip with the head capsule and a demarking of a longitudinal gular region on the under surface of the head. There is a well-defined tendency toward a thickening of the fore wings in some Plecoptera, and in certain of them the fore wings become greatly shortened, and but few veins (mostly the longitudinal ones) are retained in some cases. In the Embiids, the tendency toward the retention of the longitudinal parallel venation is even more marked; but the thickening of the wings is not so pronounced, although traces of it are to be found even among the Embiids. The thickening of the fore wings to form elytra is very marked in the Dermaptera, in which they are extremely like the elytra of certain Coleoptera. Some of the flattened Dermaptera such as *Hemimerus* have broader pronota resembling the pronota of certain Lampyrids, while other Dermaptera have narrower pronota like those of other Lampyrids. The neck plates of the Coleoptera are more like those of the Embiids, but the prothoracic sclerites of the Coleoptera are more like those of certain Dermaptera, in which the trochantinus intervenes between the bases of the coxa and the pleural region which tends to unite with the pronotum in both groups. The legs of the Coleoptera could readily be derived from the Dermaptetron type, except that the tarsi of the Dermaptera, like most of the other primitive members of the Panplecopteron group, are trimerous. The posterior coxæ of the Coleoptera are more like those of the Embiids than those of the Dermaptera, and the general plan of the meso- and metathoracic sclerites (with the exception of the tergal region) is somewhat more alike in the Embiids and Coleoptera, although the mesonotal and metanotal regions of the Coleoptera and Dermaptera are astonishingly similar even to the minutest details, as was pointed out in a paper dealing with this subject in Vol. 25 of Psyche (p. 4). The abdnominal paranota (lateral projections of the tergal region) of certain Lampyrids and other Coleoptera are also present in such Dermaptera as *Ancistrogaster luctuosus* Stal. It may be remarked in passing, that the paranota are very ancient structures occurring in Palæodictyoptera, certain primitive Ephemerida (nymphs

and adults) and other lowly organized insects, and their retention in the Coleoptera must therefore be regarded as a very primitive feature. As I have pointed out in several papers, the cerci of such larval Coleoptera as *Galerita janus* Fab., are remarkably similar to those of such nymphal Dermaptera as *Diplatys severa* and *Karschiella* even in regard to such minute details as the relative size of the individual segments, etc.; and the paraprocts (lateral plates near anal opening) and genitalia of the Coleoptera could readily be derived from the Dermapteron type.

It has been argued that such Coleoptera as the Staphylinidæ, which have retained a body-form strongly resembling that of certain Dermaptera, are highly specialized in many respects. This however has no bearing on the structural resemblance of certain Lampyroid Coleoptera (which are very primitive in their general makeup) to certain Dermapters, and it by no means disproves the contention that the Staphylinidæ have retained a primitive body form, despite the presence in some of them of rather highly specialized characters. Every student of evolution and comparative anatomy knows full well that animals which are very primitive in some respects may have developed certain other characters to a rather high degree of specialization, and on this account, we have to take the *composite* primitive characters (gleaned from many sources) of a group in order to arrive at a correct conclusion concerning the nature of the forms ancestral to that group; and what may be termed the "forerunners" of these composite primitive characters are to be sought among the more primitive representatives of the superorder of which the group in question is a member. On this account, we must examine not only the Dermaptera, but also the Embiids and Plecoptera in order to ascertain the probable origin of the ancestral features found in the Coleoptera, although some one group, such as the Dermaptera, would naturally be expected to retain more of these ancestral features than the others have done.

It must be borne in mind that both the Psocidæ (*sensu lato*) and the Neuroptera were probably descended from Plecoptera-life forebears, and therefore it is merely to be expected that similar characters would be carried over into both the Dermaptero-Coleopteron lines of descent and the Psocid-Neuropteron lines of descent. The characters which they all have in common would therefore be inherited from their common ancestral stock (related to the Plecoptera), and would merely indicate that Coleoptera, Psocidæ and Neuroptera are to be traced back to more primitive common ancestors (resembling Plecoptera) rather than that Coleoptera are descended from the rather highly developed Psocidæ, or even from the Neuroptera. Furthermore, the Blattidæ, Grylloblattidæ and their relatives, are very probably ultimately descended from forms not unlike the ancestors of the Plecoptera, and since they have remained very primitive in many respects, it is not surprising that they too exhibit certain features suggesting a condition ancestral to the Coleoptera and Dermaptera; but the closest affinities of the Dermaptera are with the Embiids and Plecoptera, and the closest affinities of the Coleoptera are with the Dermaptera and their allies, so that we are justified in assuming that the nearest living representative of the immediate ancestors of the Coleoptera are the Dermaptera, which are more primitive structurally than the Coleoptera, and have therefore departed less than they from the ancestral condition.

It has been argued that the known fossil remains of the Dermaptera are not as old geologically, as the first Coleoptera to appear, and on this account the Coleoptera cannot be derived from Dermaptera-like forebears. In this connection, however, I would simply call to mind the fact that formerly it was contended that the anatom-

ically more primitive Coleoptera genuina could not represent the ancestral condition of the group since the fossil remains of the more highly specialized Rhynchophora antedated them geologically. Later, however, discoveries of earlier Coleoptera genuina completely vindicated comparative anatomy, and showed that the lack of known remains of earlier Coleoptera genuina was merely due to the incompleteness of the palæontological record—and I cannot help feeling that the same will hold true in the case of the Dermaptera. The Dermaptera are not nearly as numerous as the Coleoptera, and, since the preservation of fossil remains is so largely a matter of chance (as is their discovery also), it is merely to be expected that fewer Dermaptera than Coleoptera will be discovered, and their apparent absence in the older strata will doubtless prove to be simply a case of incompleteness of our record, rather than a case of their not occurring in a period contemporaneous with, or antecedent to, the appearance of the Coleoptera upon the scene.

In Psyche, Vol. 25, page 4, it was stated that the Coleoptera should be included in the superorder Panplecoptera, and that the Strepsiptera might possibly be included with them also. I have recently examined some Strepsipteron material, however, which would indicate that the closest affinities of the Strepsiptera are with the Hemipteroid insects and other forms descended from Psocid-like or Neuroptera-like forebears; so that until more details of Strepsipteron anatomy, and the range of variation in the group, are known it is preferable to reserve opinion in the matter of their closest affinities, until all of the available evidence on the subject is forthcoming.

As to the relationships of the other orders of living winged insects, they might be grouped into five main superorders as follows: the *Panneuroptera,* comprising the Siphonaptera and Diptera, the Mecoptera, Neuroptera, Hymenoptera, Trichoptera and Lepidoptera with their allies; the *Panhomoptera* comprising the Psocidæ, Mallophaga, Thysanoptera, Anopleura, Hemiptera and Homoptera with their allies; the *Panplecoptera* including the Coleoptera, Dermaptera, Embiidæ, Plecoptera and their relatives; the *Panorthoptera,* comprising the "Locustidæ," Gryllidæ, "Acrididæ," Tridactylidæ, Phasmids, Grylloblattids and their relatives; and the *Panisoptera,* comprising the Blattidæ, Mantidæ, Zoraptera and Isoptera, with their immediate relatives. The Odonata and Ephemerida were formerly grouped in a sixth superorder, the *Panplectoptera,* but they have not a great deal in common, and there is some question in my mind whether the Ephemerida should be placed here, or with the Plecopteron group, with which they also have certain features in common. The Ephemerida likewise resemble certain fossil Palæodictyoptera in many respects, and it is also possible that these should be grouped together; but until more is known concerning the anatomical details of these fossil forms, it is impossible to place them correctly, since the study of the wing venation, or any one set of structures, is entirely inadequqate evidence upon which to base one's conclusions.

There are a few orders of insects which are extremely difficult to place definitely. Thus, the Tenthredinoid Hymenoptera have a surprisingly large number of features in common with the Mecoptera (e.g. male genitalia, thoracic sclerites, head and mouth parts, etc.) and it is very probable that they should be grouped in the same super order with the Mecoptera; but these Hymenoptera likewise exhibit a number of features in common with the Psocidæ, thus making it extremely difficult to determine their exact affinities. The other order of living winged insects not accounted for is the Strepsiptera, and these are even more difficult to place. They have much in common with the insects descended from Psocid-like forebears, and might possibly be

included in the superorder containing these forms. On the other hand there is much that is suggestive of Coleopteron affinities in the Strepsiptera, and until more is known of their anatomy and development, it is preferable to suspend judgment in the matter of determining their closest affinities until the necessary evidence is forthcoming.

Of the fossil insects, so little is known concerning the details of their anatomy, that it is futile to attempt to determine which superorders they should be grouped with (or whether they belong in new superorders) until more is known concerning them than the bare details of their wing venation. It may be mentioned in passing, however, that the so-called Protorthopetra should doubtless be grouped in the superorder Panorthoptera. The Protoblattoidea resemble certain members of the Panplecoptera in some respects, and if their closest affinities are with the Blattids as most palæontologists maintain, they may serve to connect the Blattid-group with the Panplecoptera. Such Palæodictyoptera as *Stenodictya* have cerci like those of the Plecoptera, and the abdominal paranota of *Stenodictya* are very like those of certain members of the Panplecoptera such as the Lampyrids, Dermaptera (*Ancistrogaster*) etc. The wings of Stenodictyia are quite comparable to those of certain Plecoptera, and its head could be readily referred to the Plecopteron type in certain features. The tarsi too seem to be trimerous in *Stenodictya* as in the more primitive representatives of the group Panplecoptera. On the other hand, *Stenodictyia* exhibits a great many characters suggestive of affinities with the Ephemerida, and the determination of the closest affinities of those fossil forms must await the further study of their anatomical details which can be more satisfactorily carried out when better preserved specimens than the present-known fragments are available for examination.

General Structure of Phoronis Pacifica Torrey

RUTH LEDIG

Phoronis lives in tubes formed by particles of sand and small pebbles which are held together very firmly by a secretion from the body. These tubes are entirely separate from each other. In preserving the animals for sections the tubes were usually removed from the animals before fixation. The usual picric or mercuric fixing reagents seemed to give good results. After sectioning or before, a carmine or hematoxylin stain was used; the latter gave the best results, followed with eosin. The animals are so small and delicate that it was necessary to study their anatomy by means of serial sections.

In Phoronis the buccal and anal openings are both in the anterior end of the animal. The head end has two lopophore organs bearing numerous tentacles arranged spirally. The digestive tract is U shaped. This species varies in length, based on the material at hand it is from one to two and one-half inches in length.

The vascular system consists of a circular ring of the blood vessel about the esophagus. From this ring vessels run into each tentacle and one vessel follows and is parallel with the digestive tract. Opposite to this vessel is one returning the blood to the circumesophageal ring.

The nervous system consists of a ganglion between the anal and the mouth opening, It is made of modified surface cells. From this ganglion a circle of nervous tissue extends about the esophagus and from this a single unsymmetrical nerve or sense organ runs the length of the body in the epithelium of the body wall.

Two nephridia are found, each of which is situated near the surface equally distant from the anal opening.

Phoronis pacifica has both testis and ovary in the same individual.

Further details of structure are shown in the figures.

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(Contribution from the Zoological Laboratory of Pomona College)

EXPLANATION OF FIGURES

Fig. 1. Cross section of the lopophore organs of *Phoronis pacifica* showing sections of tentacles. X 70.

(a) Each tentacle is made up of a circular band of muscle within which is found a small blood vessel.

Fig. 2. Cross section of base of lopophore organ of *Phoronis,* showing the beginning of the buccal cavity, the anal opening and the bases of the tentacles. X 70.

Fig. 3. Cross section of the anterior end of *Phoronis.* X70.

(a) Digestive tract., (b) blood, (c) nerve ganglion, (d) nephridia, (e) anal end of intestine, (f) base of tentacles.

Fig. 4. Cross section through the upper end of the body of Phoronis. X 70.

(a) esophagus, (b) blood, (c) dorsal blood vessel, (d) intestine, (e) nephridia, (f) epithelium of body cavity.

Fig. 5. Section of the body of *Phoronis* farther back. X70.

(a) stomach, (b) blood, (c) mesentery, (d) nerve, (e) intestine, (f) epithelium, (g) longitudinal muscles of body wall.

Fig. 6. Section through the body of *Phoronis* near the end of the body. X70. (a) gonads, (b) stomach, (c) intestine, (d) mesentery, (e) epithelium, (f) longitudinal muscle of body wall, (g) circular muscle of body wall, (h) longitudinal nerve?

Fig. 7. Section of body wall. X300.

(a) epithelium of surface, (b) circular muscle, (c) longitudinal muscle.

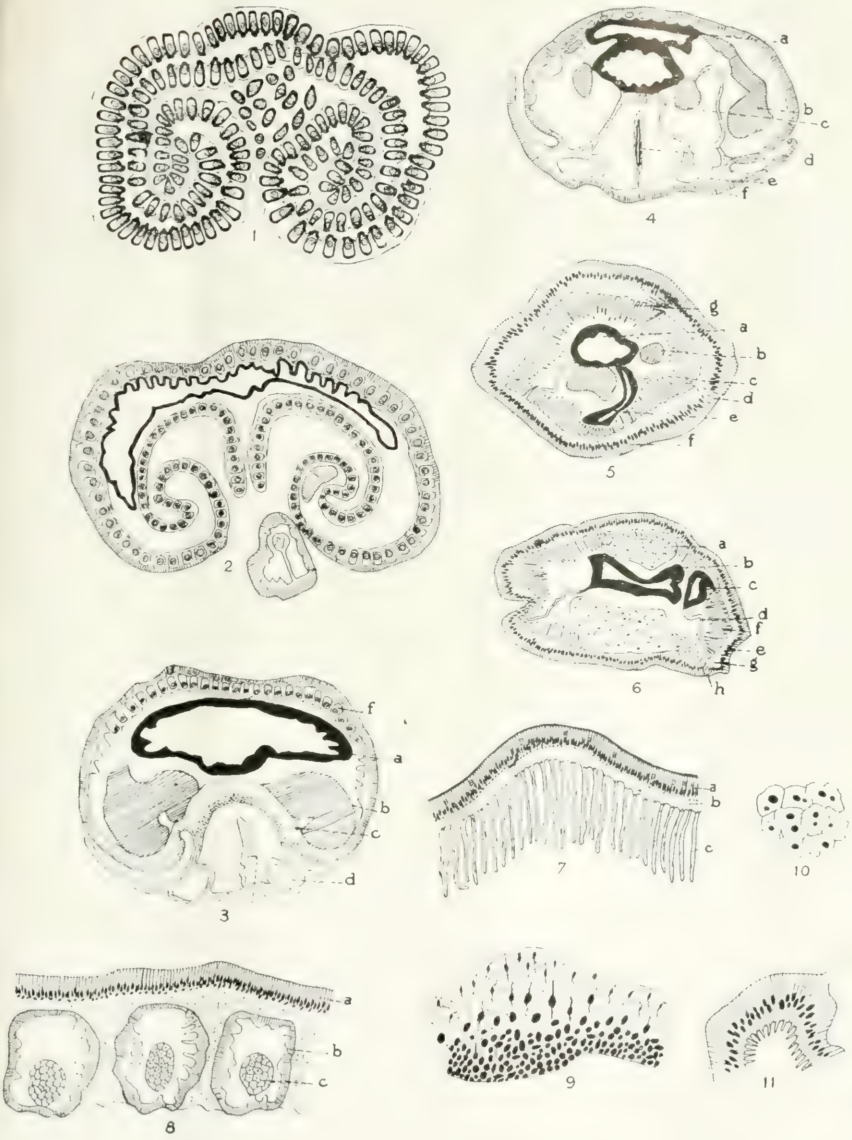
Fig. 8. Section base of tentacles. X300.

(a) epithelium, (b) muscle, (c) blood.

Fig. 9. Section of ganglion of *Phoronis.* X300.

Fig. 10. Blood corpuscles massed together. X300.

Fig. 11. Section of ciliated epithelium of digestive tract. X300.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Acarina from Claremont-Laguna Region

The present list is from specimens collected during the past years. The determinations are by Dr. Nathan Banks.

Dermanyssus gallinae Redi. From chickens, some from other situation.

Parasitus frontalis Bks. From wild mouse. Laguna Beach.

Parasitus sp. Not mature. Free living, Claremont.

Parasitus sp. Free living, not mature. Chino Swamps.

Anystis agilis Bks. Claremont, on ground. Abundant in March, 1918, and also in other years. Small red.

Trombidium pacificum Bks. Medium sized dark red, from ant's nest also from Evey canon.

T. claremonti Bks. Evey canon.

T. magnificum Leconte Mts. near Claremont, 8,000 ft. elevation. Large dark red mite. Johnston Col.

Trombidium sp. Near Camp Baldy, 4,500 ft. elevation. Johnston Col.

Bdella pergrina Bks. Claremont, Calif. Common. Also Chino Swamps.

Penthaleus bicolor Bks. Spherical, dark body, red legs. Common Claremont in spring.

Tarsotomus terminalis Bks. Small mites. Head of San Dimas canon.

Erythæus hiltoni Bks. Claremont.

Erythæus sp. not mature. Claremont.

Macrocheles sp. Chino Swamp.

TICKS

Argas miniatus Koch. Large ticks, exact location of capture unknown.

Dermacentor occidentalis Neum. Mts. near Claremont. Pudding stone canon, Evey's canon.

Hæmaphysalis leporis palustris Pack. On rabbit, Claremont.

Ixodes californicus Bks. Laguna Beach. Also on dog, Claremont. W. A. H.

(*Contribution from the Zoological Laboratory of Pomona College*)

The Central Nervous System of Dolichoglossus

WILLIAM A. HILTON

Specimens were fixed in the living condition in mercuric chloride or other strong reagents and cut in series. Hematozylin stains seemed best for details.

A study of the nervous system of this animal suggests similar structures in echinoderms. The surface epithelium is in many places underlaid with nerve strands. In some places these nerve fibers are very thick, in others only a few strands are evident. The epithlium of the surfaces of the proboscis, collar and body is of varying thickness and ciliated. Among the columnar cells there are in places numbers of modified mucous secreting cells or goblet cells. In some places also there are specialized nerve or sense cells which are modified epithelial cells whose processes are slender and run as nerve fibers below the layer of nuclei. Multipolar cells also occur.

We may speak of the nervous system as being the lower fibrous layer of the epithelium in many parts of the body. This central nervous system is especially thickened on the dorsal side of the body, particularly at the junction of the proboscis and collar and also under the collar on the dorsal side. The part which might be called the brain is the band of nervous tissue which separates itself from the surface of the collar on the dorsal side yet retains a large number of cells and a thick band of fibers. This dorsal nervous system is connected with a longitudinal thickening on the dorsal side of the animal below the collar, but it is only slightly connected with the poorly developed sub-epithelial thickening on the dorsal side of the collar. There is very little indication of a ventral nerve cord in the region of the collar.

The nervous system under the epithelium of the proboscis has nerve fibers under it in about the same degree of thickness at all points. Local variations of thickness are probably due to special contractions at the time the specimen was killed.

In all parts but the dorsal region of the collar the nervous system is intimately associated with surface epithelium. At the region of the collar the dorsal strand is made up of some cells and many longitudinal fibers. Below the collar the dorsal nerve band continues to be definitely marked from other parts of the epithelium and looks much like the nerve trunk of the starfish. The same is true in less degree of the smaller ventral nerve trunk which is seen below the collar.

The nerve cells seem to be of two sorts. First those which may in part be sensory, bipolar cells reaching from near the surface down into the fibrous band. These cells usually fork at the inner surface of the fiber layer and give off minute branches as they pass through the fiber area. Second, multipolar cells whose bodies are located in the deeper layers of the nuclei with one or more branches which run into the fibrous area.

The general appearance of a band of nerve fibers under the nuclear layers is a mass of fine branches with many cross lines and very many finer longitudinal strands which cannot be followed very far as individuals. The cross lines are those fibers which in some cases can be seen to be continuations of the cells of the epithelium. The fine longitudinal lines are in large part the small lateral branches of the cross fibers just mentioned. There is quite a dense network of fibers in all parts of the fibrous

nervous system. In detail the structures are quite different from those of echinoderms where the strands from cells in most cases seem to be almost the only processes in the fiber areas. In Dolichoglossus there are not such long slanting fibers from single cells as in echinoderms and conduction seems possible chiefly through the small and apparently short lateral branches of the long nerve cells. Possibly the branched inner ends of the cells furnish some means of conduction. These last resemble similar structures in certain echinoderms. The fine lateral branches and the absence of crossing lateral fibers seems to show a slightly more advanced type of structure than we find in the starfish group. In the central part of the nervous system, that is the dorsal nerve of the collar, longitudinal fibers are more evident than in other parts.

No distinction between fiber and fibril could be seen. The larger strands did not seem to be made up of smaller ones and the smaller ones seemed to be processes of larger ones.

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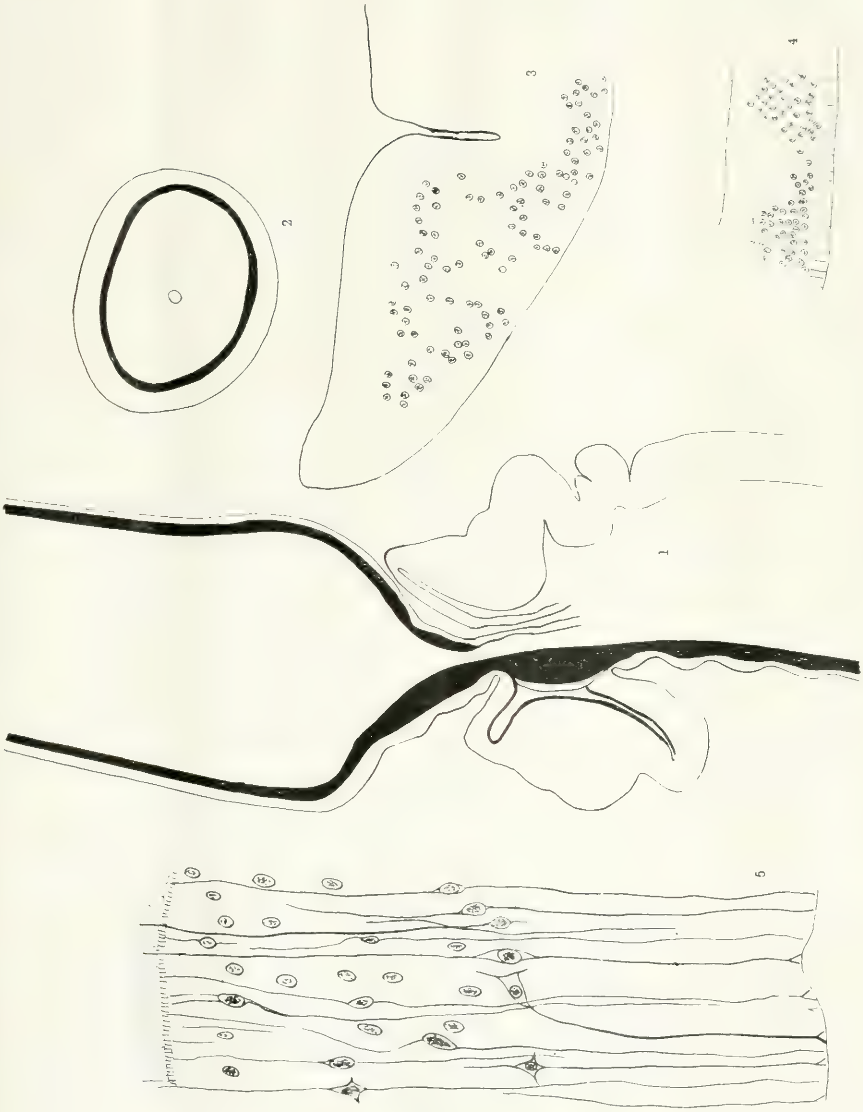
EXPLANATION OF FIGURES

Fig. 1. Longitudinal section of part of the proboscis, the collar and part of the body of *Dolichoglossus*. The dorsal side is at the left. The nervous system is shown by heavy lines. X35.

Fig. 2. Cross section of the proboscis showing the position of the nervous system as a heavy line. X35.

Figs. 3 and 4. Sections of parts of dorsal and ventral nerve trunks. The outside is down. X300.

Fig. 5. Section through epithelium and nerve strand showing epithelial and nerve cells. X450.



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